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AUTHOR Wells, Kathleen M.
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ABSTRACT

Kamehameha Schools (Honolulu, Hawaii), a privately funded program with approximately 2,000 students and 175 teachers grades 7-12, is implementing a school-wide curriculum evaluation program. As part of this program, the departments of mathematics, science, social studies, counseling, human relations, speech and English collaborated in the development and administration of a Critical Thinking Skills Performance Assessment. The assessment was designed to check the ability of 12th graders to: understand information related to a serious social issue, decide on a plan of action to solve some aspect of the problem, and organize the information and their plan of action into a logical case to gain the support of community "decision-makers." The assessment was administered to a sample of 90 male and female students of low, moderate and high ability. Two sessions totalling 4.5 hours were allowed for administration. Student "cases" were evaluated by four to five teachers using a structured rating sheet. Results indicate that the majority of students have not mastered critical thinking criteria set by our teachers. Plans are being made for staff and curriculum development leading to more explicit instruction in thinking skills, common criteria for evaluation of student skills across departments and on-going assessment at the school level. (Author)

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The Development of a Critical Thinking Skills Performance Assessment: An Interdisciplinary Approach to Validating Achievement of School Goals

Kathleen M. Wells
The Kamehameha Schools
Honolulu, Hawaii

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Kathleen M. Wells
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ABSTRACT

Kamehameha Schools, a privately funded program with approximately 2000 students and 175 teachers grades 7-12, is implementing a school-wide curriculum evaluation program. As part of this program, the departments of Math, Science, Social Studies, Counseling, Human Relations, Speech and English collaborated in the development and administration of a Critical Thinking Skills performance Assessment. The assessment was designed to check the ability of 12th graders to: understand information related to a serious social issue, decide on a plan of action to solve some aspect of the problem. organize the information and their plan of action into a logical case to gain the support of community "decision-makers."

The assessment was administered to a sample of 90 male and female students of low, moderate and high ability. Two sessions totalling 4.5 hours were allowed for administration. Student "cases" were evaluated by 4-5 teachers using a structured rating sheet. Results indicate that the majority of students have not mastered critical thinking criteria set by our teachers. Plans are being made for staff and curriculum development leading to more explicit instruction in thinking skills, common criteria for evaluation of student skills across departments and on-going assessment at the school level.

THE DEVELOPMENT OF A CRITICAL THINKING SKILLS PERFORMANCE ASSESSMENT: AN INTERDISCIPLINARY APPROACH TO VALIDATING ACHIEVEMENT OF SCHOOL GOALS

Kamehameha Secondary School is a privately funded program with approximately 170 teachers and 2,069 students, grades 7-12. Kamehameha, like most educational institutions, has a list of "School Goals for Students" which indicate those broad, generalized abilities students and parents can expect to see develop via participation in the educational activities provided by the School. We are in the process of implementing a system to improve the effectiveness and efficiency of the cumulative experiences of our "core" curriculum in fostering student achievement of the stated goals.

The system, called the Exit Skills Program, has three main functions. The first is to provide assistance to faculty of all 15 instructional departments in identifying the major departmental outcomes to be achieved by graduating students and the link between these outcomes and the School Goals. (For example, "The ability to perform mathematical manipulations" is one of five outcomes for the Mathematics department and is linked to the School Goal of "Knowledge of numbers and their operations"). The resulting School Goals by departmental outcomes matrix (see Appendix A) defines the intended impact of each department on School Goals and points out commonalities between departments so that collaborative efforts can be initiated.

Secondly, the Program coordinates efforts within and across departments to assess the extent to which the portion of School Goals for which teachers have declared responsibility is being achieved. A variety of assessment formats are used (e.g., performance assessments, multiple-choice tests, teacher observations and product evaluations) to simulate the situations and tasks teachers expect students

to be able to respond to successfully by the time they graduate.

Finally, the Program organizes and reports information from these assessments to administrators and faculty for use in evaluating and modifying curriculum. Thus far, all departments have identified outcomes and their links to School Goals; instruments have been developed and administered to assess outcomes related to various aspects of ten of our fifteen School Goals; feedback from assessments is being used in curriculum workshops, evaluation of graduation requirements and other decision-making settings.

An important feature of this program is the collaborative nature of activities directed at assessing achievement of those School Goals believed to result from an accumulation of experiences across many instructional areas, such as "The ability to think critically and solve problems" (GOAL III. C.). Assessment in these areas is based on conceptual models and criteria developed jointly by the departments involved. We believe that the use of common conceptual models and criteria will provide clarity and focus to the activities of teachers and students.

However, we are in the early stages of implementing this program. Since the feasibility of developing common models and the usefulness of such models once developed are still open questions, we decided to focus our collaborative efforts on one major goal area during the 1981-82 school year. Critical thinking skills, identified by seven of our instructional departments as one of their highest priority outcomes, was selected as the area of focus. The departments involved were: English, Human Relations, Counseling, Science, Mathematics, Social Studies and Speech.

DEVELOPMENT OF THE CRITICAL THINKING SKILLS PERFORMANCE ASSESSMENT

The Test Plan

The heads of all involved departments met to compare and discuss their critical thinking exit skill statements and to consider the possibility of developing an interdepartmental assessment.

The department heads felt that, although they expected students to apply critical thinking strategies to different types of content, the skills involved were conceptually the same. They agreed to meet weekly to 1) develop a general model identifying stages in the problem-solving process and critical thinking skills needed to progress through the stages; and 2) develop an interdepartmental assessment. An assumption behind this decision was that use of a common model in the development and evaluation of these skills across disciplines would assist students in transferring learning from one course to another.

The group spent a good deal of time working to articulate concepts that they had been using on a more intuitive basis with their students. It became apparent that we could spend years researching this area before feeling comfortable with our task. Although the numerous models of intellectual functioning available (e.g., those of Bloom and Guilford) have more commonalities than differences, the task of understanding the theories and research underlying the models and relating this information to curriculum concerns is a major endeavor.

We decided to proceed with the idea that this year's work would be a foundation upon which we and others could build. Our general procedure was to obtain an overview of existing models and terminology by reading selected materials and to synthesize these ideas and our own into a workable framework.

As an initial step, we defined several terms to reduce confusion in our discussions:

1) A problem is a situation for which no routine solution process applies and for which alternative solutions exist. (For example, the selection of the "best" courses to take in preparation for college or the development of means for reducing environmental pollution are "problems.").
2) The problem-solving process is the series of stages an individual would progress through to efficiently address and solve some aspect of a problem.
3) Critical thinking is the ability to process data (facts, observations, etc.) into meaningful relationships.

The group agreed that the ability to think critically is essential to success at each stage of the problem-solving process and provides direction to overall activities. We then drafted and outlined a general model of the problem-solving process and identified behaviors indicative of critical thinking at each step of the process (see outline of General Model on the following page).

GENERAL MODEL OF THE PROBLEM-SOLVING PROCESS AND
EXAMPLES OF CRITICAL THINKING BEHAVIORS*

STAGES IN THE PROCESS	EXAMPLE BEHAVIORS
Stage 1: Understanding the Problem	
Step a. Identify components of the problem.	Identifies critical elements; identifies irrelevant elements; Searches for cues and patterns; identifies the goal; differentiates facts from opinions, rational from irrational arguments.
Step b. State the problem clearly.	Draws a figure or diagram; Answers questions such as What is it? When did it occur? How extensive is it?
Step c. Obtain information to better understand the problem.	Notices "gaps" in information; identifies information which might fill in the "gaps;" Asks questions, reads etc. to obtain the information; Summarizes information obtained.
Stage 2: Planning a Solution	
Step a. Identify alternatives.	Relates problem statement to information obtained; uses system or method for identifying relationships; Brainstorms; Tries to avoid "set" responses - attempts to think divergently.
Step b. Choose "best" solution.	Identifies constraints relevant to the problem such as available resources, criteria and values; Matches solution alternatives to constraints; Estimates results and outcomes of various solution alternatives.
Stage 3: Checking the solution	
Step a. Develop a plan for checking the solution.	Identifies events which should or should not occur if choice of solution is "best;" specifies steps to be followed in check; Considers existing constraints.
Step b. Carry out the plan.	Follows the outlined steps; Collects relevant information; makes relevant observations.
Stage 4: Evaluating Results	
Step a. Draw conclusions.	Relates results to predictions made; Looks for sources of errors; Accepts, rejects or revises solution strategy based on results.
Step b. Relate results to general understanding.	Suggests applications to other areas; shares insights.

*NOTE: The language of this model is general, indicating common elements across disciplines. For application to instructional activities for a specific discipline, such as Science, this general model and an appropriately worded Science version could be presented side-by-side. For example:

General Model	Science Model
Stage 3	Stage 3
Step a. Develop a plan for checking the solution.	Step a. Design an experiment for testing the hypothesis.

However, in the course of doing this, the group came to appreciate the "inelegance" of the thinking process. That is, although an efficient sequence of steps can be listed, the progress of a critical thinker would probably more closely approximate an upward spiral—a kind of weaving back and forth based on a building understanding of the problem and the formulation and testing of one idea after another.

Thus, although the developed model would be useful in instruction, knowledge of steps in the problem-solving process or the ability to move sequentially through specific steps appeared to be unreasonable graduation-point assessment objectives. Instead, the group decided to focus on evaluation of student products for evidence of critical thinking. We wanted to know how well our students could reason their way from recognition of a complex problem to presentation of a logically cohesive case recommending action for solving some aspect of the problem.

Assessment Materials and Instructions

A variety of local and national environmental and social issues were considered for selection as the "problem" students would address. "Funding for Teenage Pregnancy Prevention Projects" was selected due to its interest for high school age students and its immediacy since Federal budget cuts would result in the termination of seven out of nine such projects in Hawaii by the end of 1982.

To minimize the effects of variation in knowledge related to the issue on student performance, we assembled identical folders of materials for each student regarding aspects of teenage pregnancy from sources throughout the State. All selected materials were current, well-written and together provided sufficient information to comprehend the extent of the problems associated with teen

pregnancy and contributing factors which could be addressed through education and other community efforts. To increase student interest and involvement in the issue, a movie depicting a 15 and 17 year-old couple dealing with the stress of pregnancy was selected for showing at the beginning of the assessment.

Instructions to students indicated that funds for Teen Pregnancy Prevention Projects in Hawaii were being severely reduced. Their task was to watch the movie, read the materials and develop a case for presentation to their State legislator which would convince him or her to work for allocation of funds for one of three existing projects described in the folder or a project designed by the student.

The assessment schedule called for two sessions of approximately three hours each on consecutive days. Students would be instructed to complete a draft of their case by the end of Session I and, depending on their group, either complete a finished essay or present a speech by the end of Session II.

Five criteria were defined for evaluation of student cases: 1) Content Accuracy, 2) Statement of Problem, 3) Statement of Recommendation, 4) Statement of Logical Link between Problem and Recommendation, and 5) Overall Quality of Logical Support provided for the recommendation. All criteria would be evaluated on a zero to four point rating scale which indicated behaviors warranting specific points. Weights for the criteria toward total score varied from 1 to 3 with the last two criteria mentioned receiving the greatest weight.

The Field Test

In early March, the assessment materials were field-tested on a sample of 12 eleventh graders made up of equal numbers of "poor" and "excellent" critical

thinkers (as indicated by teachers and counselors). These students were informed of the purpose of the field-test and were asked to comment on problems and suggest possible improvements at the end of each of the two assessment sessions. All student cases for the field-test were presented as essays.

The student essays, with identifying information removed, were read and rated by at least two of the involved department heads using the rating scale described above. These ratings were compared for consistency and then averaged to obtain a single score for each student. The scores were examined to check the degree to which the "poor" and "excellent" critical thinkers were differentiated. The degree of separation was good.

Assessment materials and the rating sheet were then modified to incorporate feedback from students and department heads and prepared for administration.

PROCEDURES

Sample Selection

Samples of 58 and 26 twelfth graders were selected for the essay and speech versions, respectively, of this assessment. These samples were made up of proportionate numbers of male and female students of low, moderate and high ability (as indicated by scores obtained on the Preliminary Scholastic Aptitude Test).

The students were asked to report as scheduled to the two assessment sessions, were informed of the purpose of the assessment and were told that although they would find out the results of their work, the results would not be placed on their transcripts.

Administration

The essay and speech versions of this assessment were administered separately.

Session I: Session I was identical for both the essay and speech groups. The movie Teenage Father was shown to all students in the group during the first class period of the session. At the end of the movie, students broke into smaller groups of 20 or fewer and moved to assigned rooms. Examiners, using identical written instructions, administered the remainder of the session. Students were given materials and paper for note-taking and preparation of their drafted cases.

Breaks were taken at regular intervals. All rooms provided ample working space for the students. Four class periods (approximately 3 hours) were allowed for administration. At the end of the session, students handed-in their drafted cases as instructed.

Session II - The Essay Group: Examiners using identical written instructions administered Session II to groups of 20 or fewer students. The students reported to assigned rooms and received their materials and essay drafts prepared the previous day. They were instructed to review the materials and their drafts and prepare their finished essay.

Breaks were taken at regular intervals. Three class periods (approximately 2 hours, 15 minutes) were allowed for administration. At the end of the session, students handed in their finished essays as instructed.

Session II - The Speech Group: The Speech department head, assisted by several teachers and camera operators, administered Session II. Students reported

to the assigned room according to a staggered schedule. The schedule was devised to accommodate the need for individual video-taping of speech presentations. Students moved from a preparation room to a practice room to the speech presentation room according to timed intervals. This procedure met the needs of students at different phases of preparation and provided equal amounts of preparation time to all students.

Speeches were presented to an audience of students supervised by a teacher. All speeches were video-taped.

Rating

All essays and video-taped speeches were rated according to the criteria described above. Teachers rating essays received copies of the essays, rating sheets and instructions. Teachers rating the video-taped speeches received copies of the rating sheets and instructions and viewed the speeches on reserve at our Learning Center.

Four to five Kamehameha teachers and two teachers from other schools rated each of the essays and speeches. These teachers represented all departments involved in the assessment.

After determining that there were no significant differences between ratings of Kamehameha and "outside" teachers and that the inter-rater reliability was high, ratings were averaged to derive single scores for specific criteria and a total score for each student.

RESULTS

Results from administration of the essay and speech versions of the Critical Thinking Skills Performance Assessment were combined and are presented as

follows: a) Summary of Assessment Characteristics; b) Overall Results; c) Frequency Distribution of Scores; and d) Results for Components of the Assessment.

A. Summary of Assessment Characteristics

Assessment Characteristics	Grade 12
1. Number in group	84
2. Maximum possible score	47
3. Range of obtained scores	10.1-43.8
4. Mean: Raw/% correct	29.1/61.9%
5. Standard Deviation	8.44
6. Standard error of mean	.92
* 7. KR-20 estimate of inter-rater reliability	.83
8. Standard error of measurement using above	3.48

*Technique for estimating inter-rater reliability across multiple raters was taken from Robert L. Ebel, Essentials of Educational Measurement (Englewood Cliffs, 1972), p. 419.

B. Overall Results

Actual Performance	Grade 12	
	Mean (raw)	Mean (%)
Total group	29.1	61.9%
*Low ability students	23.8	50.7%
High ability students	34.4	73.3%
Teacher estimate of total group perf.	32.4	69.0%
Teacher definition of "mastery" level performance	36.0	77.0%
**Kamehameha ratings/"outside" ratings	29.3/30.9	62.4%/65.8%

*Ability indicator: Scores obtained on the Preliminary Scholastic Aptitude Test.

**Comparison of ratings of student products made by four-five Kamehameha teachers and teachers from other schools.

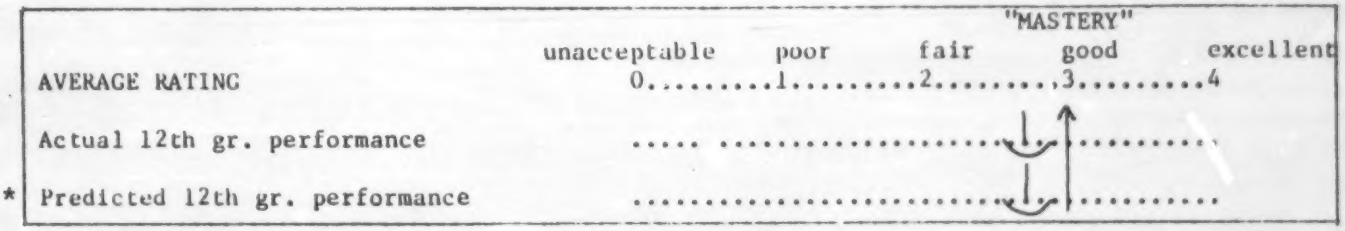
C. Frequency Distribution of Scores

Maximum possible score = 47; X = 1 student.

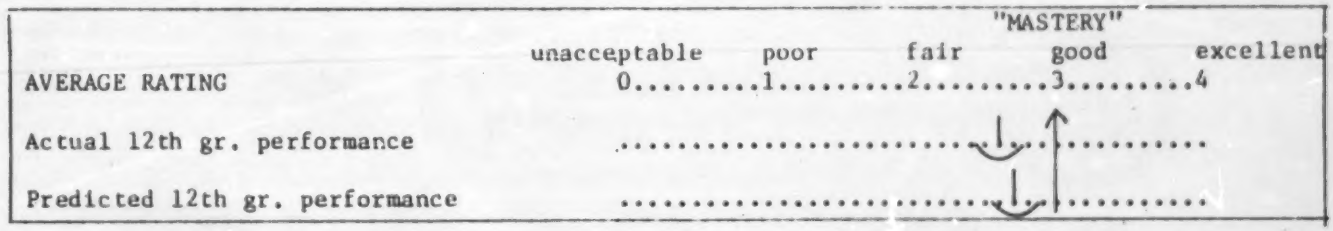
Highest Score obtained	Number of 12th graders obtaining score (84 in grp)	
43.0-43.9	XXX	
42.0-42.9	XXXX	
41.0-41.9	XX	
40.0-40.9		
39.0-39.9	XXXX	
38.0-38.9	XX	
37.0-37.9	XXXXX	
36.0-36.9	XXX	
35.0-35.9	XXXX	
34.0-34.9	XXX	
33.0-33.9	XX	
32.0-32.9	XXXXX	
31.0-31.9	XXXXX	
30.0-30.9	XX	MEDIAN
29.0-29.9	XXX	MEAN
28.0-28.9	XXX	
27.0-27.9	XXXX	
26.0-26.9	XXX	
25.0-25.9	X	
24.0-24.9	XX	
23.0-23.9	XXX	
22.0-22.9	XXXX	
21.0-21.9	XX	
20.0-20.9	XX	
19.0-19.9	XXXX	
18.9-18.9	X	
17.0-17.9	X	
16.0-16.9	XXX	
15.0-15.9	X	
14.0-14.9	X	
13.0-13.9		
12.0-12.9	X	
11.0-11.9		
10.0-10.9	X	
Lowest Score obtained		

D. Results for components of assessment

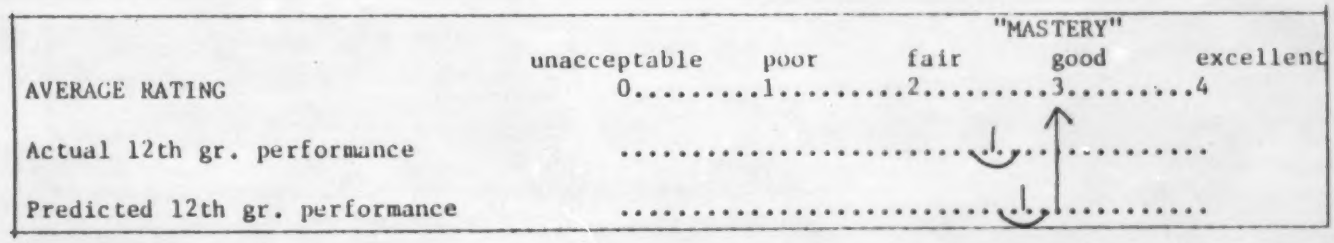
CRITERION: Content accuracy



CRITERION: Statement of Problem



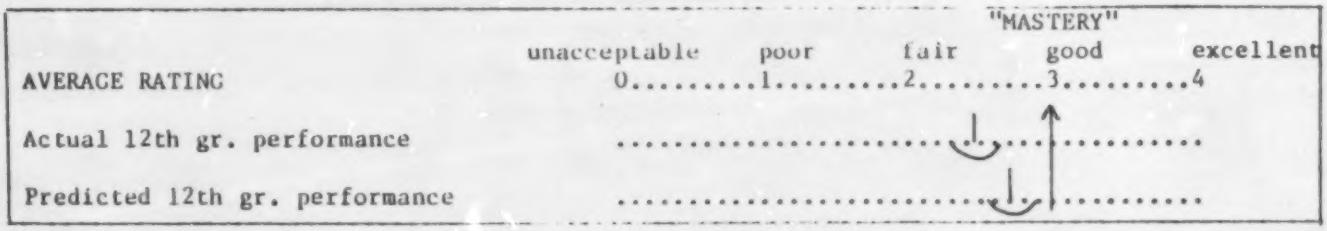
CRITERION: Statement of recommendation



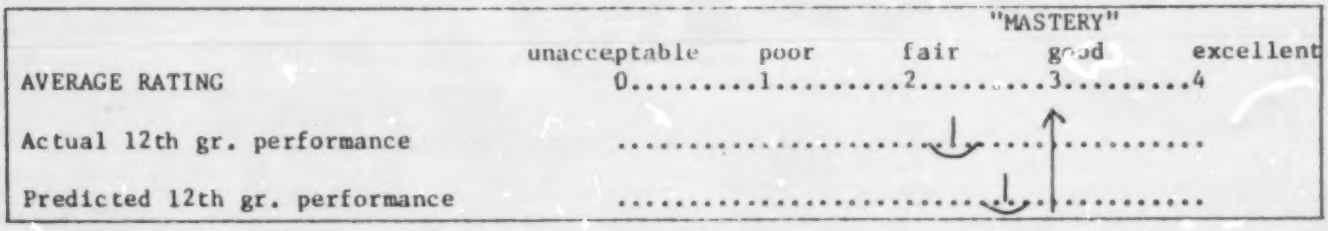
*Teachers from all involved departments predicted actual levels of 12th grade performance for each criterion.

NOTE: Half-circle "bands" under performance markers indicate the approximate standard error of the mean for use in evaluating differences between actual and "predicted" performance.

CRITERION: Statement of logical link between problem and recommendation



CRITERION: Rationale - logical support for recommendation



DISCUSSION

Our teachers found it very difficult to verbalize their definitions of critical thinking, their strategies for approaching and solving problems and their criteria for evaluating the thinking of their students. It appears that much of our "instruction" in critical thinking has been a matter of teacher demonstration, without explanation, of personally developed strategies and methods or presentation of problems followed by long-ago worked-out solutions. Unnecessary variation in language and emphases across disciplines such as Science, Social Studies and Mathematics has confused students and has been a barrier to the transfer of learning from one course to another.

Our very bright students seem to be able to fill in the gaps or develop their own techniques. However, the majority of our students need more explicit instruction and practice in "critical thinking" strategies and feedback which is tied to criteria reinforced across grade levels and instructional areas.

This year's progress toward articulating a common conceptual model and criteria and the information obtained from the assessment will form the base for next year's assessment and for development of interdisciplinary strategies for better supporting achievement of this School Goal. The process will continue. The impact of all this activity on future student achievement will take years to determine but we are pleased with present increases in teacher involvement and discussion within and across departments and optimistic that the process will prove productive.

APPENDIX A

Departmental Outcomes

SCHOOL GOALS FOR STUDENTS	Art	Business Education	Counseling	English	Hawaiian Studies	Health/ Human Rel.	Industrial Education	JROTC	Languages	Math	Music/ Drama	Physical Education	Science	Social Studies	Speech
I. PERSONAL AND INTERPERSONAL SKILLS															
The student should be able to . . .															
A. Identify personal strengths, attitudes and interests and select activities which facilitate personal growth.			X	X											X
B. Demonstrate an awareness of the relationship between personal behavior and the responses of others.						X		X	X						X
C. Define a system of values which reflects positive feelings about self and others and awareness of the rights and responsibilities of the individual within society.						X		X				X		X	X
D. Demonstrate awareness of career possibilities and the values, attitudes and skills affecting success in various careers.		X	X				X	X		X			X		
E. Demonstrate an understanding of issues and strategies related to the management of personal resources.		X				X									
II. HEALTH SKILLS															
The students should be able to . . .															
A. Demonstrate knowledge and understanding of factors related to the achievement and maintenance of emotional and physical health.						X	X	X				X			
B. Plan a program of activities which fosters emotional and physical health.						X						X			

SCHOOL GOALS FOR STUDENTS	Art	Business Education	Counseling	English	Hawaiian Studies	Health/ Human/Rel.	Industrial Education	JROTC	Languages	Math	Music/ Drama	Physical Education	Science	Social Studies	Speech
II. LEARNER SKILLS															
The student should be able to . . .															
A. Demonstrate the ability to read, write, listen and speak effectively.				X				X	X					X	X
B. Demonstrate knowledge of numbers and their operations.										X					
C. Demonstrate the ability to think critically and solve problems.			X	X		X				X			X	X	X
V. CULTURAL SKILLS															
The students should be able to . . .															
A. Demonstrate awareness of creative expressions of mankind and an understanding of the ways in which such expressions can enrich one's existence.	X			X					X		X				
B. Demonstrate an understanding and appreciation of Hawaiian culture and values.					X						X			X	
V. SOCIAL SKILLS															
The student should be able to . . .															
A. Demonstrate an understanding of the major forces affecting the present and future (e.g., economic, political, scientific, social, technological) and describe the implications of various trends and alternatives.							X	X		X			X	X	
B. Demonstrate an understanding of the means by which individuals and groups influence decisions affecting the present and future.														X	X
C. Demonstrate an understanding of contemporary Hawaiian issues and agencies.					X									X	